

Glass Turret Visualization System (GTVS)

Augmented Reality Systems Offer Low-Cost, Safer Training and Navigation Solutions for the Army and Navy



Technology and Innovation

Pathfinder Systems' DARPA SBIR project defined a method to implement a Glass Turret Visualization System (GTVS) for military platforms. A preliminary design of a brass board prototype for a Phase II demonstration was defined. Requirements for the prototype were based on the tactics and doctrine of a tank platoon, and assumed a tank commander or platoon leader as its user. In Phase I, the requirements and Preliminary Design were validated by Concept Demonstration prototype.

The basic GTVS technology is to use Augmented Reality to inject computer-generated entities into real-world, real-time user views. Examples include injecting a virtual opposing force (OPFOR) into the view of a dismounted soldier or a virtual target into the view of a tank gunner. The unique element of Pathfinder Systems' technology is that it doesn't just insert information into the view, rather, it integrates the information so that it is a coherent part of the user's worldview. In the case of a virtual entity, the entity is integrated into the view, accommodating real-world objects that may occlude a full view of the object.

This innovative technology—developed under a DARPA SBIR contract—has found its way to warfighters in a variety of different ways:



- **U.S. Army Tank and Automotive Command (TACOM):** TACOM has explored using the technology to provide marking of minefield and obstacle breaches. In this application, Augmented Reality (AR) is used to provide precision navigation to combat vehicle commanders under all visibility conditions. The same AR is used to provide general navigation information and command and control information by integrating computer-generated graphics into soldier real-time, real-world views.
- **U.S. Army Research, Development, and Engineering Command (RDECOM):** RDECOM has used the technology to begin to explore the use of Augmented Reality to support dismounted soldier training. In this application, AR is used to integrate virtual friendly and OPFOR entities into soldier views to support training and mission rehearsal. The

The seamless integration of virtual targets into real-world view offers a realistic, cost-effective training solution.



Virtual minefield breach markers allow safe ingress and egress through minefields and other hazardous areas.

same technique can also be used to inject real-time command and control (C2) information into soldier views to support the execution of cooperative tasks and enhance/expedite military decision making.

- **U.S. Navy Sea Systems Command (NAVSEA):** NAVSEA, Crane Division, Small Arms Directorate, used the AR technology developed in the GTVS program to develop a prototype gunnery training system for the Mark 38 25mm machine gun and the M-60 7.62mm machine gun. The system—dubbed the Virtual Target Gunnery System (VTAGS)—supports live and dry fire training by injecting targets into the real-world, real-time views of gunners.
- **U.S. Army Program Executive Office for Simulation, Training, and Instrumentation (PEO-STRI):** PEO-STRI has designated that GTVS technology be integrated into the U.S. Army's One Training Engagement Simulation System (OneTESS) live training instrumentation effort. The initial application will be to provide virtual targets for Bradley Fighting Vehicles in support of live fire training. Future uses will include providing a virtual OPFOR that can be seen by scout units.



Joint Collaborations

Pathfinder Systems has used its DARPA SBIR to create joint collaborations with a variety of military customers and to seek and secure additional technology funds:

1. The company has taken advantage of the FAST TRACK and Phase II Plus programs—specifically designed to encourage rapid transition of SBIR research and development technologies into commercial products—to build joint collaborations with the U.S. Army Tank-Automation Command,

"The DARPA SBIR program has been critical to us in that it gave us enough funding to build a demonstrator system. Once people could see what Augmented Reality could do, we were able to attract more funds for additional AR applications. Also, the prestige associated with the DARPA name is of extreme importance to us. We have found that with commercial investors, DARPA is often the single government organization that commercial investors recognize."

U.S. Army Research, Development, and Engineering Command, and U.S. Army Program Executive Office for Simulation, Training, and Instrumentation. In addition, the U.S. Air Force will be using Augmented Reality technology to train the loadmasters

- located in the back of C-130 aircraft. The program begins in early 2007.
2. The knowledge the company gained from its work on the DARPA SBIR program better enabled the company to access additional technology funds—in some cases by pointing out the existence and benefits of streamlined contracting procedures of which customers were unaware.
 - Originally, Pathfinder Systems' commercialization strategy was to develop new technologies—and the products utilizing these new technologies—completely in house. As a direct result of the DARPA SBIR program, however, Pathfinder Systems has made major alterations in this approach to commercializing products:
 3. The company intends to keep its core competency of technology development—licensing its technology to other firms that specialize in developing products.
 4. Where other firms cannot be engaged to license specific technologies, the company will form new entities to develop and produce products to meet customer needs.

Lessons Learned

Pathfinder Systems has developed a number of best practices including:

1. **Technology transition:** Pathfinder Systems has discovered that the best time to begin the process of transitioning technology to the military is when a company writes its Phase I proposal—not after an award is made.
2. **Technology evaluation:** Just as the company works to identify military customers when it writes its Phase I proposals, Pathfinder Systems begins planning for customer evaluation of technology at the same time. By keeping end users closely involved in the technology-development process, Pathfinder Systems increases the probability that warfighters will receive a system that not only works, but that is tailored to their specific needs—and enthusiastically embraced by military sponsors.

3. **Changing course:** Because DARPA SBIR projects are often on the leading edge of technological innovation, the course of research can change as certain avenues are tested and prove to be less promising than expected. Pathfinder Systems has found that ultimate project success requires keeping government technical points of contact fully apprised of such situations, giving them a say in new research directions.

Economic Impact

The DARPA SBIR program has been an economic catalyst for Pathfinder Systems—helping the company find and attract additional funding from a variety of agencies within the Department of Defense. By the company's estimation, its original DARPA SBIR project has been leveraged into more than \$1.4 million of additional work in the



Control measures can be immediately integrated into a real-world, real-time scene.

area of Augmented Reality. Over the course of the company's 20-year history, approximately 30 percent of Pathfinder Systems' technology development funds have been derived from the DARPA SBIR program.

As a direct result of the DARPA SBIR, Pathfinder Systems has secured one patent and is currently working on one more. The company has also negotiated a mutually beneficial license agreement with the U.S.

Pathfinder Systems

Government for the use of its Augmented Reality technology through the U.S. Army Program Executive Office for Simulation, Training, and Instrumentation.

The DARPA SBIR has helped Pathfinder Systems establish a stable economic foundation from which it has been able to develop a stable of innovative technologies which the company now plans to spin off for further development in both the defense and commercial markets. In one potential spin off, Pathfinder Systems is currently in the process of establishing a new subsidiary which will provide its proprietary neural net technology—developed under another SBIR effort—to the gaming industry. The company is also exploring the possibility of designing and manufacturing a low-cost Augmented Reality system that could be sold within the toy and entertainment industries.

About the Company

Pathfinder Systems, Inc.—founded in 1985 by Sheila Jaszlics, who also serves as president of the company—is a small, woman-owned business based in Lakewood, Colorado that specializes in the entire range of services necessary for the successful execution of complex programs and software-intensive efforts, with a specialization in executing complex research and development efforts and developing real-time simulations.

Pathfinder Systems creates value for its customers through the innovative yet practical application of emerging technology. The use of Augmented Reality (AR), for example, creates sophisticated targets that can behave in challenging ways—offering far greater utility than traditional simulations. In another example, the application of Augmented Reality for command and control (C2) can help military units successfully negotiate their way through obstacles under all kinds of weather and lighting conditions. In each case, the application of the technology reduces costs



Using Pathfinder technology developed under a DARPA SBIR, warfighters can safely engage OPFOR targets in realistic situations.

to customers while enhancing survivability of personnel and equipment. The use of virtual targets also promises to reduce range maintenance costs as well as provide a mechanism that allows military units to train anywhere, anytime. Further, using AR for navigation and command and control provides a secure and silent means to disseminate information that is easy to use, as it is embedded in the soldier's real-world view. ■

Company Information

Pathfinder Systems, Inc. 200 Union Blvd., Suite 300 Lakewood, CO 80228-1831 Phone: (303) 763-8660 Fax: (303) 763-8902 www.pathfindersystems.com	Sheila Jaszlics, President Founded: 1985 Number of employees: 7
---	---